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Dated 23 January 2001

GB9923780.2.

By virtue of a direction given under Section 30 of the Patents Act 1977, the application is proceeding in the name of

FORD-WERKE AG
Incorporated in the Federal Republic of Germany
Henry Ford Strasse
D-50725
COLOGNE
Federal Republic of Germany

[ADP No. 08027492001]

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1.	Your reference	P2073-GB
2.	Patent application number *(The Patent Office will fill in this)* **9923780.2**	08OCT99 E482672-1 002902 P01/7700 0.00 - 9923780.2
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	MILNER, Peter James 100D Leicester Road Hinckley Leicestershire
	Patents ADP number *(if you know it)*	LE10 1LU
	If the applicant is a corporate body, give the country/state of its incorporation	7160062002
4.	Title of the invention	AN OPTICAL SYSTEM
5.	Name of your agent *(if you have one)*	K R Bryer & Co
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	7 Gay Street Bath BA1 2PH
	Patents ADP number *(if you know it)*	10777002

SECTION 30(1) (1977 ACT) APPLICATION FILED 8 OCT 1999 17-11-98.

6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application		Number of earlier application	Date of filing *(day / month / year)*
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:* *a) any applicant named in part 3 is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.* *See note (d))*	No		

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Priority documents	NIL
Translation of priority documents	NIL
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	NIL
Request for preliminary examination and search *(Patents Form 9/77)*	NIL
Request for substantive examination *(Patents Form 10/77)*	NIL
Any other documents *(please specify)*	NIL

11. I/We request the grant of a patent on the basis of this application.

Signature K R Bryer & Co Date 08.10.99

12. Name and daytime telephone number of person to contact in the United Kingdom: Kenneth R Bryer 01225 428877

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AN OPTICAL SYSTEM

The present invention relates generally to an optical system for diverting light to enable an observer to obtain an additional or different field of view from that which is normally available from the observation position.

In many circumstances an observer has a limited field of view because of restrictions in the position which can be adopted by the observer and/or by screening or shrouding necessarily present in the vicinity of the observer's position, for example in the form of machine parts or housings of the observation post. A machine operator, for example, may have a field of view through a window or observation opening in the housing of a machine to enable him or her effectively to operate the machine in normal conditions. Where it is necessary to operate the machine in special circumstances it may be necessary or desirable for the observer to have a different field of view from that normally available from the observation position, which may be defined for example by a seat which necessarily therefore restricts the range of movement of the operator's head, and in some circumstances it is possible for the operator to rise from the seat in order to view the machinery from a different perspective. This is not always possible, however, and circumstances do arise in which a machine operator is constrained to

remain in the seated position to operate the machinery, and to estimate what control operations or actions should be made in order to work the machinery on the basis of estimates made by the operator as to the necessary control movement to achieve a desired objective.

Such a situation arises, for example, in a motor car when the driver is attempting to perform certain manoeuvres, especially parking. Modern aerodynamics and styling result in the extremities of the vehicle being out of the view of the driver from the driving position. It is frequently the case, therefore, that a driver cannot see the corners of a motor car and consequently parking the vehicle in a restricted space involves an estimation of the probable position of the corners of the vehicle in order to avoid contact with nearby objects. A similar situation arises when using excavating machinery comprising a bucket or claw carried at the end of an articulated arm on a body or cabin turnable about a vertical axis. The range of movement of the articulated arm can position the bucket at locations which are not visible to the machine operator when seated at the controls in view of the necessarily limited size of the window through which the operator can observe the working of the bucket. Other, similar situations arise with other forms of machinery involving moving parts.

One attempt to solve this problem has been made, in the

case of motor vehicles having very upright rear windows, by positioning a fresnel refractor on the rear window to divert light from a position close to the rear of the vehicle so that, when reversing, the driver can obtain a view, albeit somewhat distorted, of the region immediately to the rear of the vehicle, a view which would not otherwise be available due to the small size of the rear window, the opacity of the surrounding walls and the distance from the driver's eyes to the rear window.

Such a solution is not applicable in all circumstances, however, because the presence of the light-diverting refractor obstructs the normal view through that part of the window or opening occupied by it. This, in turn, limits the size to which such refractors can be usefully made as it is essential to keep a substantial part of the window or opening for the normal direct view as well as to allow the diverted view. An arrangement of this type could not, for example, be used at the front of a vehicle where substantially the entirety of the windscreen must be unobstructed in order to allow the driver to operate the vehicle safely in normal driving conditions.

The present invention seeks to provide a solution to this problem which, when applied to motor vehicles, is capable of making as much of the front exterior of the motor vehicle visible as possible and also provide a view of the road as close to the front of the vehicle as

possible.

According to one aspect of the present invention, therefore, an optical system for diverting light to enable an observer a different field of view from that visible in the absence of the system comprises a light-diverter element or system mounted in such a way that it can be moved between an operative position to be observed by an observer at a predetermined location, and an inoperative position when it is out of the line of sight of the said observer.

In its application to a motor vehicle such a device should preferably provide a view over the fullwidth of the vehicle without obstructing the normal field of view available when the light-diverting optical system is not deployed. This can be achieved in one embodiment of the invention by a system in which the said light-diverter element or system comprises or includes a refractor carried by a mounting so as to be pivotable about an axis transverse the direction of light arriving at an observer at the said predetermined location from the said field of view.

It is preferred that the said axis is located transversely of the said refractor, that is generally parallel to, and, preferably along (or spaced from) one edge of the refractor.

Preferably the refractor is a fresnel refractor, that is one comprising a plurality of elementary refracting surfaces in an array defining a general plane of the refractor.

One of the problems encountered when using refractors for light-diverting purposes arises from the chromatic aberrations which are introduced upon refraction. Such aberrations can be compensated, however, by the provision of a composite refractor comprising a plurality of refracting elements oppositely orientated with respect to their light-diverting action. An optical system in which the refractor comprises two fresnel refractors is particularly convenient although three or more refractor elements in an array may be provided.

For application to a motor car the light-diverter element or system may be mounted or mountable to one edge of a sun visor of the vehicle, and this is particularly advantageous if the mounting allows the refractor to be folded parallel to the sun visor in its retracted position whereby to occupy a minimum of space and, at the same time, be protected by the sun visor from mechanical contact and potential impacts.

In an alternative embodiment of the invention the light-diverter system comprises a composite reflector system

comprising an even number of reflectors.

A first reflector of such a reflector system may comprise a plurality of reflector elements in an array, with each element of the array being orientated transversely with respect to the general plane of the array. Such an array may be of the type generally described in the applicant's earlier British Patent No.2 255 945. The disclosure of which is incorporated herein by reference.

In a reflector embodiment the second reflector may be pivotally mounted to or adjacent one edge of the said first reflector and, as in the refractor embodiment the reflectors are preferably generally planer in form and mounted in such a way that they can be folded parallel to one another and out of the line of sight of an observer to allow the normal field of view to be unobstructed when the light-diverter is not deployed.

An embodiment of the invention may be formed in which the second reflector is a rear view mirror of a vehicle to which light from the first reflector is diverted when in an operative position.

Conveniently, the mounting assembly may be such that the relative position of the first and second reflector are adjustable to obtain a field of view therefrom in different directions in dependence on the relative

position of the adjustment of reflectors. For example, in a first deployed adjustment the diverted field of view through the optical system may include a portion of the vehicle bonnet (or hood) and the road immediately in front of the vehicle (or immediately behind the vehicle if the system is mounted in an alternative adjustment) whereas in another adjustment the diverted view may be inclined upwardly to bring, for example, traffic lights obscured by the front edge of the roof of the vehicle into view.

Various embodiments of the present invention will now be more particularly described by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side view of a first embodiment of the invention showing a light-diverter system in its deployed and stored positions;

Figure 2 is an enlarged partial view of a composite roof rack forming part of the embodiment of Figure 1;

Figure 3 is a partial view of an alternative composite refractor suitable for use in the embodiment of Figure 1;

Figure 4 is a side view of an alternative embodiment of the invention utilising reflectors rather than refractors;

Figure 5 is a side view of the embodiment of Figure 4 in an alternative orientation of use;

Figure 6 is a side view of a further alternative

embodiment of the invention utilising the vehicle's own rear view mirror as part of the light-diverting optical system;

Figure 7 is a diagrammatic illustration of a rear view through a windscreen of a motor vehicle with the light-diverting optical system out of use; and

Figure 8 is a schematic diagram illustrating the same view as Figure 7, but with a light-diverting optical system deployed to provide a modified field of view.

Referring now to the drawings, Figure 1 illustrates a first embodiment of the invention adapted for use in a motor car generally indicated 11. In Figure 1 only the front upper portion 12 of the roof of the motor vehicle is illustrated, together with an upper part of the windscreen 13.

A known rear view mirror assembly 14 mounted on a bracket 15 secured to the windscreen 13 by adhesive is also illustrated for comparative purposes. A sun visor assembly generally indicated 16 comprises two panels 17, 18 pivotally connected together at a distal edge along a pivot axis generally indicated 19 to allow the panels 17, 18 to be displaced from a closed or stored configuration with the panels lying parallel to one another, as shown to the right of Figure 1, to an open or deployed configuration as illustrated to the left of Figure 1. Between these two end positions, the sun visor 16 may

also be turned to a shading position generally indicated by the central position in Figure 1, in which the two panels 17, 18 remain closed against one another allowing the sun visor to be used in its conventional manner.

With the panels 17, 18 of the sunvisor 16 opened out, as shown to the left of Figure 1, a light-diverting optical component 20, normally enclosed between the two panels 17, 18 can be turned to a deployed or operative position as illustrated by the broken line 21 of Figure 1. In the deployed position the light-diverting optical component acts to refract light arriving from a forward region of the vehicle, represented by the ray traces A and B towards an observer's eyes generally indicated E thereby allowing a view of the front of the vehicle and the road immediately ahead of it to be obtained from the restricted position of a driver in the driving seat.

The refractor panel 20 in this embodiment is a composite fresnel refractor comprising two elements as illustrated in Figure 2. It will be appreciated that Figure 2 illustrates only a very small part of the fresnel refractor 20, comprising only two elementary prisms of each of two refractor sheets 22, 23. In practice their would be many more across the width of the element as a whole.

Each of the refractors 22, 23 which form part of the

composite refractor 20 is made of an optically transparent material which may be the same or preferably a different material, in particular having different refractive indices from each other. The refractor 22 has a plain face 24 and an opposite face having a plurality of inclined elementary surfaces 25 separated by "risers" 26 to form a plurality of adjacent elementary prisms generally indicated 27, 28. The refractor element 23, likewise, has a plane face 29, and an opposite face in the form of a plurality of individual elementary surfaces 30, 31 separated by "risers" 32 to define elementary prisms 33, 34. In general, a composite refractor suitable for this purpose comprises at least two optical elements of different material from one another positioned with their prismatic apex angles oriented oppositely from one another as illustrated in Figure 2. The inclination of the elementary surfaces 31, 30 to the plane surface 29 in the element 23, together with the choice of reflective index of the material from which the element 23 is made cause it to introduce an opposite chromatic dispersion from that introduced by the element 24 as light is transmitted through it. As a result the light arriving at an observer O provides an image which is not degraded by chromatic aberrations. The dimensions of the elementary surfaces 25, 31, 30 are typically of the order of 1mm and flat sheets of fresnel refractor may be produced using so-called micro-replication techniques employing thermo plastic material such as PMNA or PC

using "nanometre precision" tooling produced by single point diamond machining. The two sheets 23, 24 may be assembled by bonding together using a transparent adhesive. Although shown as a flat sheet 20 in Figure 1 the composite refractor may, of course, be curved in one or more directions to enlarge or reduce the field of view. Likewise the inclination of the refractor 20 may be adjusted in order to select the field of view available through it, whereby to accommodate the precise position of the eyes E of different observers.

Figure 3 illustrates an alternative composite refractor surface in which there are three fresnel refractors rather than the two illustrated in Figure 2. In this embodiment the refractor 23 has been replaced by two thinner refracts 35, 36 each having inclined elementary surfaces defining prism apex angles in the same direction, both being in the opposite direction from that of the apex angles of the refractor 24. This constructor allows a shorter path length for the refractor light through each of the optical elements 35, 36 than through the optical element 23 of Figure 2, thereby obtaining improved optical properties.

Figure 4 illustrates an alternative embodiment of the invention comprising a light-diverter assembly generally indicated 37 composed of two separate reflectors 38, 39 pivotally connected together along a common parallel edge

by a pivotable connection 40 and one of which, the reflector 38, is pivotally mounted at 41 to the roof 12 of the vehicle adjacent the upper edge of the windscreen 13.

In this embodiment the reflector 38 comprises a stacked elementary reflector array of the type described in the applicant's earlier British Patent 2 255 945, namely one in which the reflective surfaces are formed as parallel elementary surfaces perpendicular to the general plane of the element itself. This may be achieved by stacking together an array of sheets of transparent material and then cutting through the array perpendicular to the places of the elements to provide cut sheets with a plurality of parallel interfaces or, alternatively, by bringing together two elements having parallel grooves or other indentations which, in the composite element define a plurality of reflective facets which are offset from one another parallel to the general place of the array.

The reflector array 38 is pivotally mounted at a proximal edge by a pivot 41 to the roof 12, and by a pivot 40 at its distal edge to a plane reflector 39. The pivotable connections 40, 41 allow the two reflectors 38, 39 to be extended to the deployed position illustrated in Figure 4 or two a folded or "parked" position (not illustrated) in which both lie substantially parallel to one another and to the windscreen 13 above the rear view mirror 14

and out of the direct line of sight of the driver when observing the external environment through the windscreen 13. This embodiment of the invention acts independently of the sun visor which is shown as a conventional sun visor 44 in Figure 4.

Figure 5 illustrates the embodiment of Figure 4 in an alternative deployed position with the composite elemental reflector array 38 located substantially parallel to the windscreen 13 and at an angle slightly less than 90° to the plane reflector 39. As shown by the ray traces C and D this then acts to divert light from above the vehicle, from a point which would be obstructed from the observer's view by the front edge of the roof 12, such as traffic lights located close to the vehicle. This can arise if a vehicle is brought to rest rather to far forward of its intended position at a traffic light-controlled junction.

Figure 6 illustrates a further alternative embodiment of the invention comprising a single hinged reflector array 45 of the transverse reflector type (SERRA) which may have the structure of the stacked array 38 of Figure 4. In this embodiment, however, the rear view mirror 14 is utilised as the second reflector by rocking it to the position illustrated in Figure 6.

As will be seen in Figures 7 and 8, by deploying the

light diverter of the present invention, as shown in Figure 8, the front portion of the vehicle and the road immediately ahead of it is brought into view to aid manoeuvring the vehicle to assist in avoiding obstructions which would not be visible to the driver, as shown in Figures 7, simply by observing the normal field of view from the driving position.

1/7

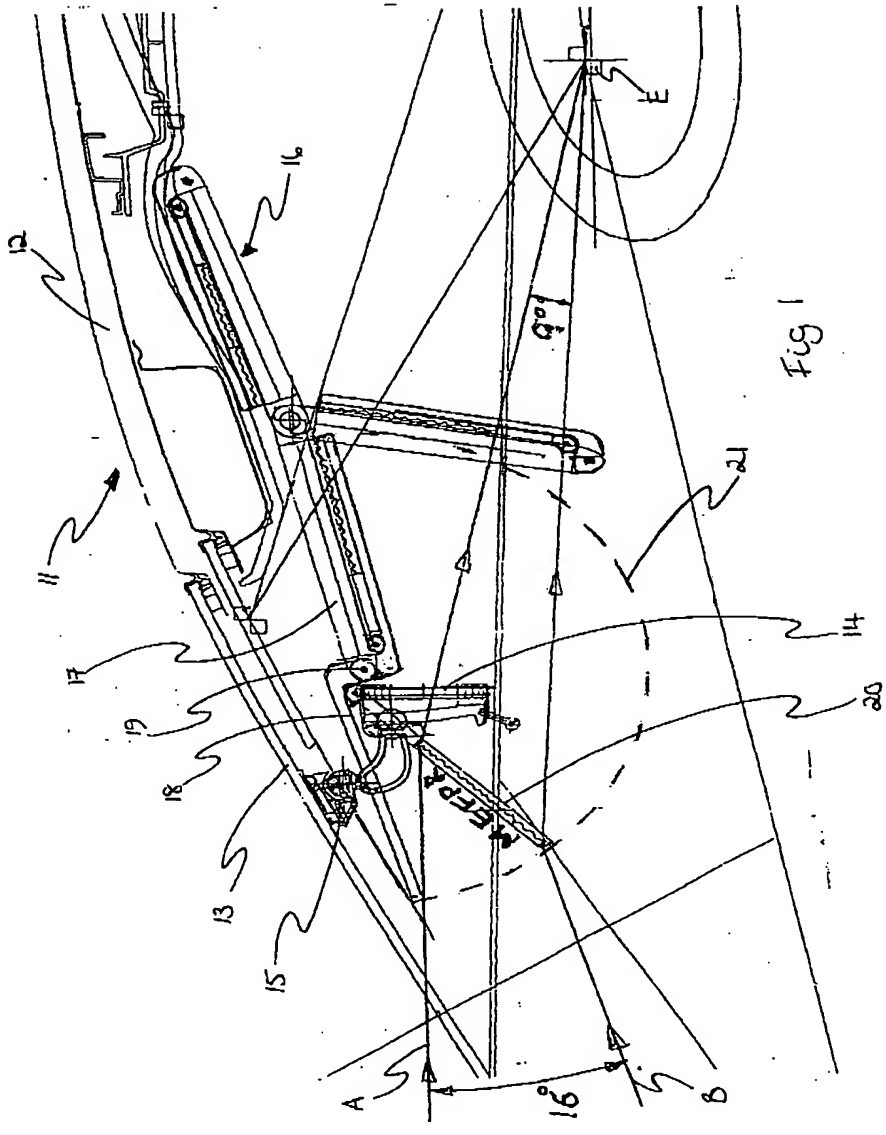

Fig 1

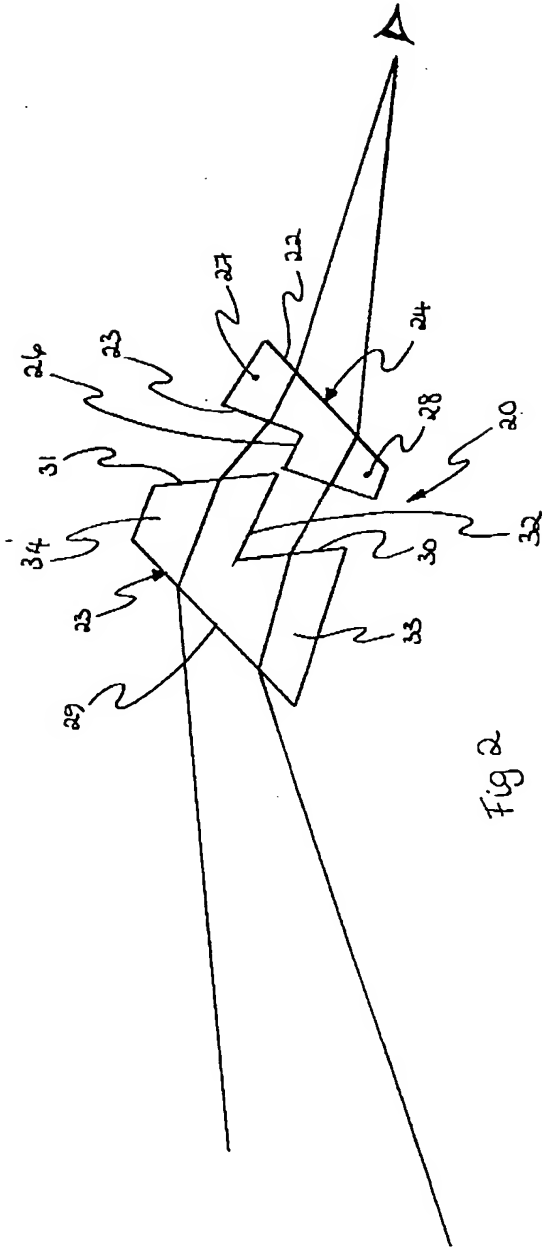

Fig 2

3 / 7

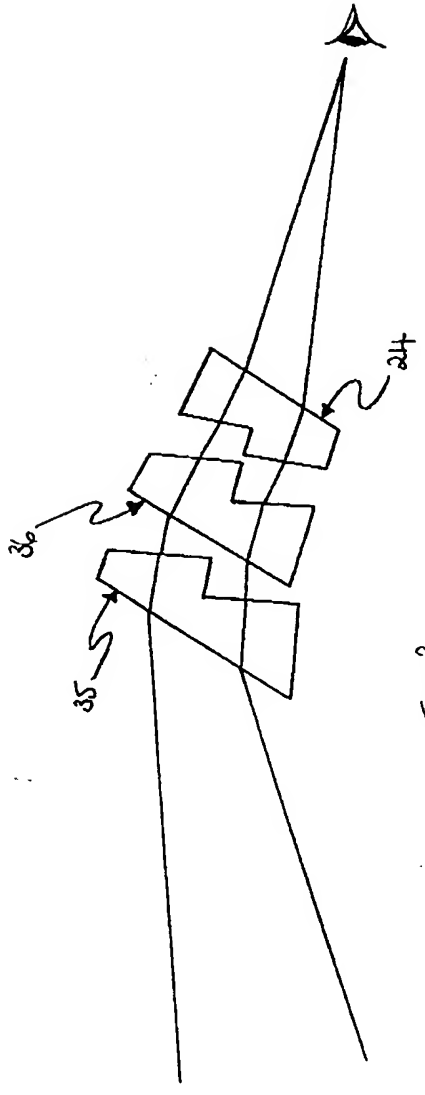

Fig 3

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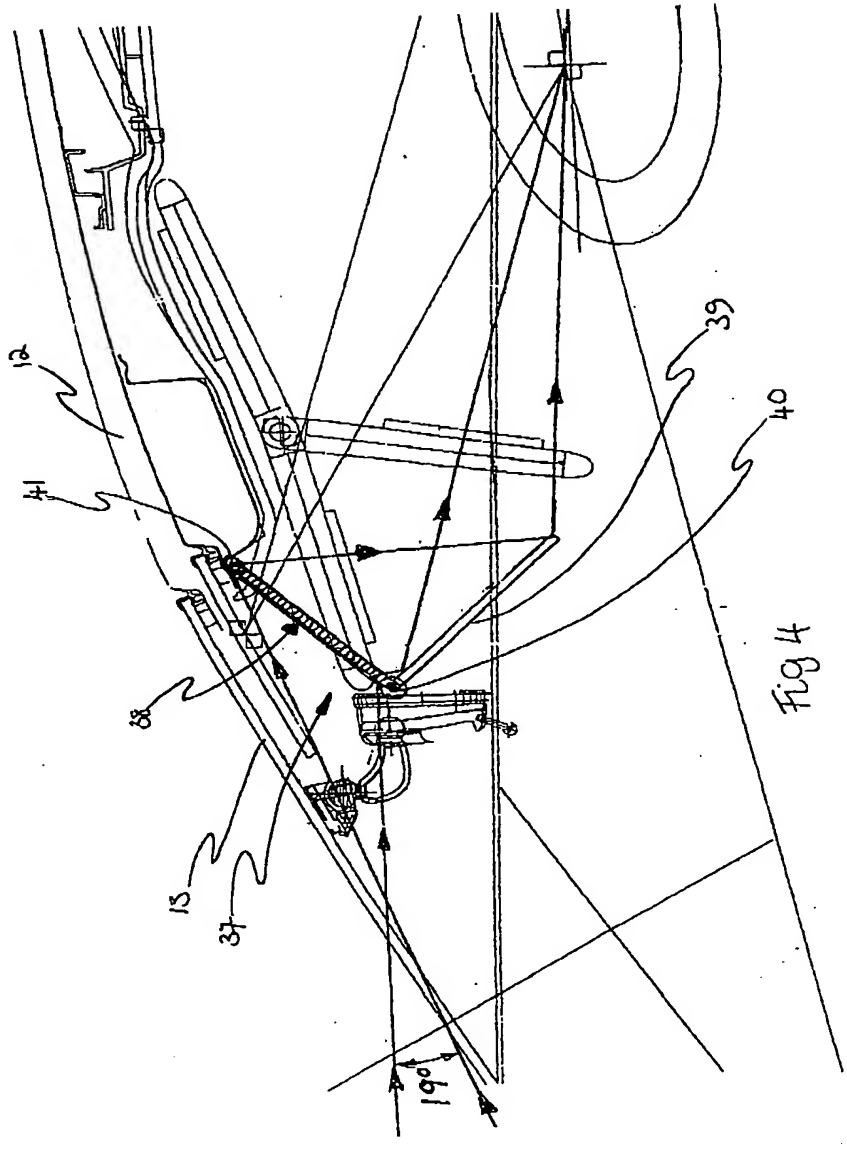

Fig 4

5 / 7

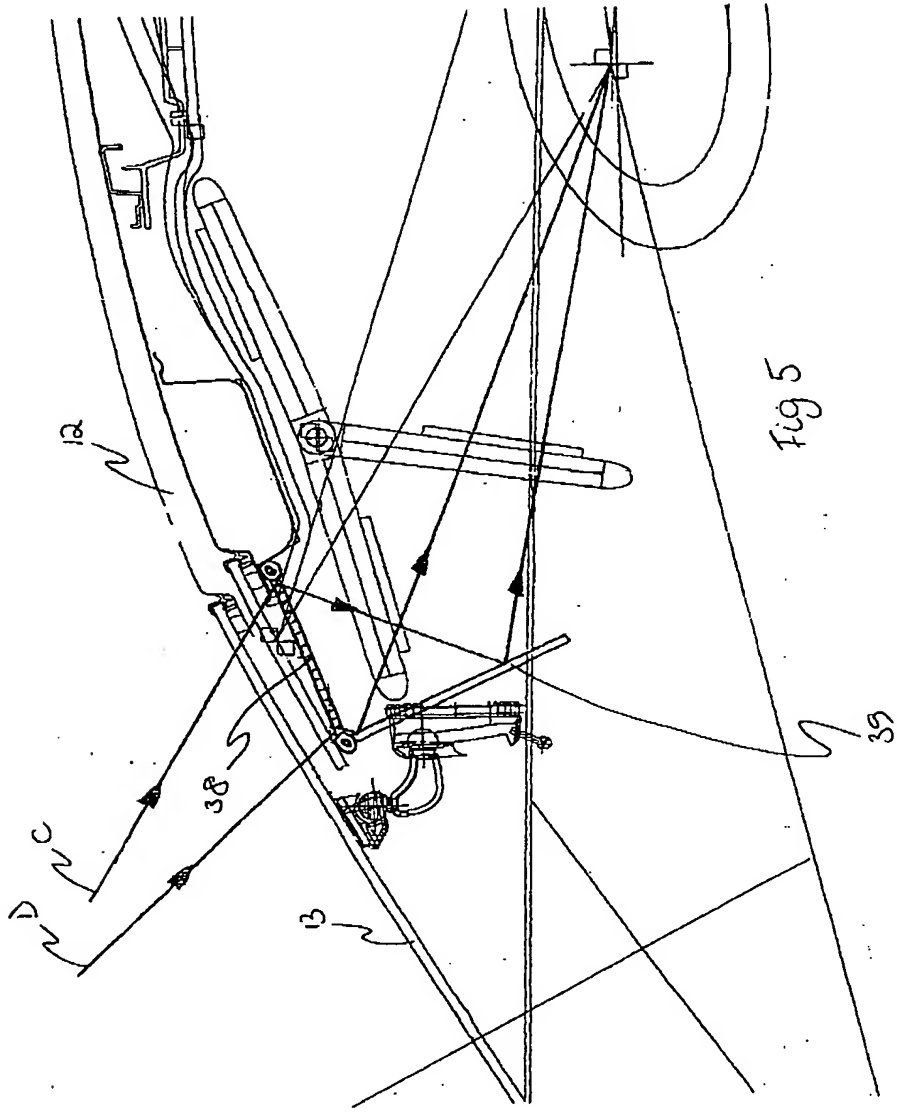

Fig 5

6 / 7

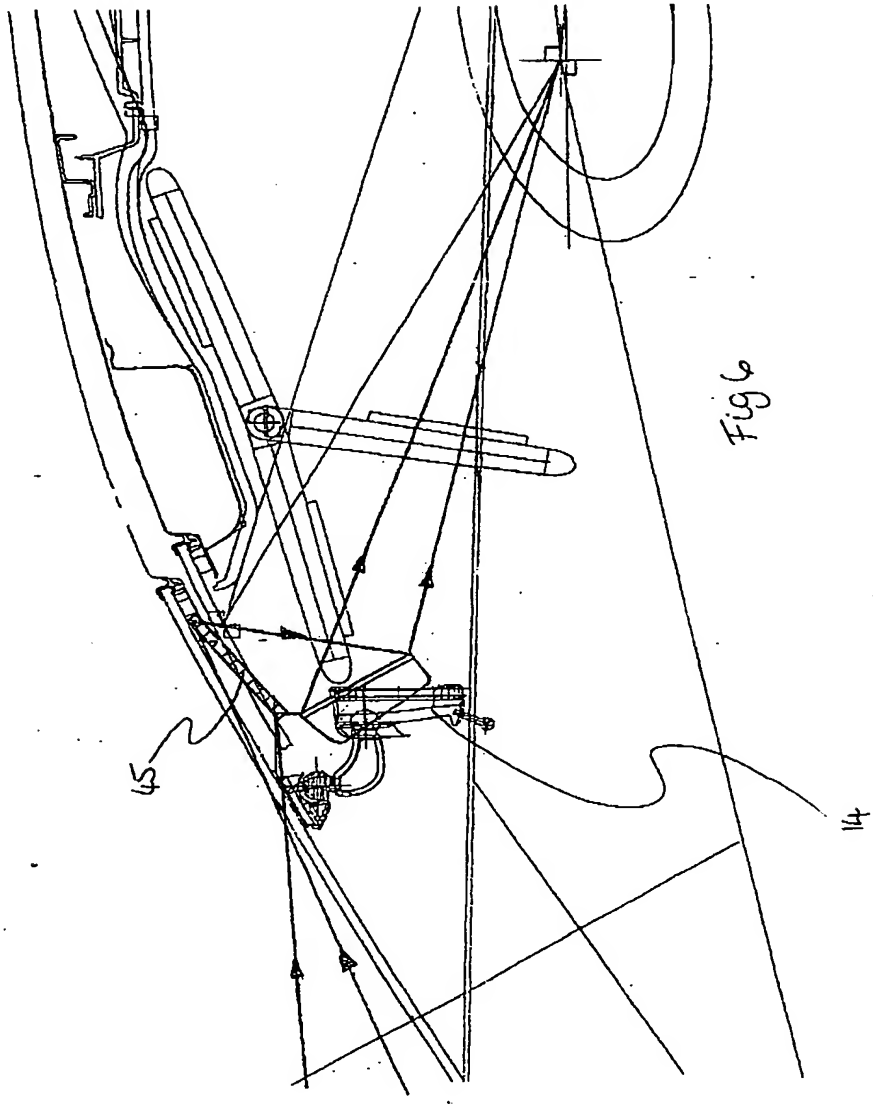

Fig 6

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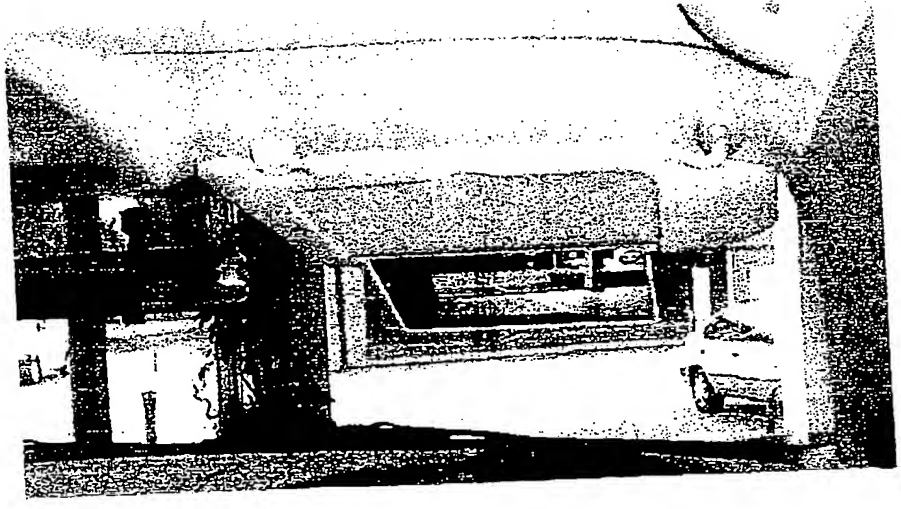
Fig 7



Fig